Designation: D5323 – 92 (Reapproved 2006)

Standard Practice for Determination of 2 % Secant Modulus for Polyethylene Geomembranes[1]

This standard is issued under the fixed designation D5323; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice presents a technique for calculating the 2 % secant modulus for polyethylene geomembranes between 0.5 and 5 mm (20 and 200 mil) using Test Method D638.

1.2 This practice will facilitate modulus comparisons of similar materials by standardizing the method for deriving the points on the stress-strain curve from which the calculations are performed.

1.3 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D638 Test Method for Tensile Properties of Plastics

3. Terminology

3.1 *Definitions:*

3.1.1 *modulus of elasticity,* MPa (FL^{-2}), *n*—the ratio of stress (nominal) to corresponding strain below the proportional limit of a material, expressed in force per unit area, such as megapascals (pounds-force per square inch).

3.1.1.1 *Discussion*—The stress-strain relations of many plastics do not conform to Hooke's law throughout the elastic range, but rather deviate therefrom even at strains well below the elastic limit. For such materials, the slope of the tangent to the stress-strain curve at a low strain is usually taken as the modulus of elasticity (or elastic modulus). Since the existence of a true proportional limit in polyethylene is questionable, and with the impracticality of measuring it reliably, the use of secant modulus for comparative evaluations is preferred.

3.1.2 *secant modulus*, *n*—the ratio of stress (nominal) to corresponding strain at any specified point on the stress-strain curve.

3.1.2.1 *Discussion*—The measurement units for secant modulus may change, depending on the standard used. For the purposes of this practice, the measurement units shall be force per unit area (FL^{-2}), such as megapascals (pounds-force per square inch).

4. Significance and Use

4.1 Where to draw the tangent to determine the modulus of elasticity is often unclear when performing tensile tests with polyethylene geomembranes. This problem results in a wide variation in test results and therefore makes this property unreliable for comparisons.

4.2 A secant modulus based on 2 % strain can be useful when making comparisons between materials, in quality control, and in comparing the same sample after being subjected to a nonstandard environment.

4.3 Secant modulus is an approximation of modulus of elasticity and generally results in a lower value than that for the modulus of elasticity.

4.4 Although the technique for measuring 2 % secant modulus is described here, other percent secant moduli can be measured by this practice.

5. Procedure

5.1 Follow the test procedure described in Test Method D638.

5.1.1 A cross-head speed of 50 mm/min (2 ipm) is recommended for determining secant modulus, regardless of the type of geomembrane being evaluated. Faster cross-head speeds reduce resolution of the points on the curve.

5.1.2 High resolution of load and cross-head movement is important for obtaining accurate and reproducible values. Where possible, use settings on the testing equipment that will magnify this region.

[1] This practice is under the jurisdiction of ASTM Committee D35 on Geosynthetics and is the direct responsibility of Subcommittee D35.10 on Geomembranes.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.